

Amendments to the Claims:

This listing of claims replaces all prior versions and listings of claims in the application:

Listing of Claims:

1. (Currently Amended) A computer-implemented method for providing convergence of multiple copies of a table to a same state in asynchronous data replication in a database system, the database system including a plurality of nodes with a plurality of table-copies each having a corresponding copy of the table, the method comprising:

(a) labeling rows of the plurality of table copies with a monotonic number, a copy identification, and propagation controls; for each row of each table copy, associating a timestamp with the row, the timestamp indicating a time when a change to the row has occurred;

associating a copy identification to the row, the copy identification being an identifier that uniquely identifies the table copy to which the row belongs; and associating propagation controls with the row, the propagation controls indicating whether a change to the row should be communicated to other table copies based at least in part on the timestamp of the change or the copy identification associated with the row;

(b) asynchronously capturing at least one labeled a change to any a row of a given table copy any of the plurality of table copies from a database recovery log, the database recovery log containing an entry that describes the change to the row of the given table copy;

(c) determining that the captured change to the row of the given table copy is to be communicated to others of the plurality of other table copies in the database system, the determination being made in accordance with the indication of the propagation controls associated with the changed row of the given table copy;

(d) communicating the captured change to the ~~others of the plurality of other~~ table copies in the database system; and

(e) applying the communicated change to the ~~others of the plurality of other~~ table copies in the database system, wherein the ~~plurality of table copies converge each table copy in the database system converges~~ to a same state.

2. (Currently Amended) The method of claim 1, wherein the timestamp comprises a monotonic number comprising having a non-decreasing time value, wherein the time values for each of the ~~plurality of table copies are table copy is~~ in a common time base.

3. (Currently Amended) The method of claim 2, wherein the monotonic number is automatically applied to a changed table copy associating a timestamp with the row includes associating the timestamp with the row in response to a user induced change of the row.

4. (Currently Amended) The method of claim 1, ~~wherein the copy identification is assigned to each of the plurality of table copies, wherein the copy identification uniquely identifies each of the plurality of table copies, wherein the copy identifications for identification uniquely identifying each of the plurality of table copies have table copy has an ordering property.~~

5. (Currently Amended) The method of claim 4, wherein the copy identification is automatically applied to a changed table copy associating a copy identification to the row includes associating the copy identification to the row in response to a user induced change of the row.

6. (Original) The method of claim 1, wherein the propagation controls comprise a delete label and a conflict label.

7. (Currently Amended) The method of claim 6, wherein the delete label indicates that a row delete in ~~any of the plurality of table copies a given table copy~~ is not to be communicated to ~~the others of the plurality of other table copies in the database system~~.

8. (Currently Amended) The method of claim 6, wherein the conflict label indicates that an implicit row delete in ~~any of the plurality of table copies a given table copy~~ is to be communicated to ~~the others of the plurality of other table copies in the database system, an implicit row delete being a deletion of a row due to a conflict~~.

9. (Currently Amended) The method of claim 4 6, wherein ~~the asynchronously capturing~~
(b) a change to a row of a given table copy comprises:
 (b1) accessing at least one the entry of the database recovery log pertaining to the labeled change of the row;
 (b2) determining a type of the labeled change to the row;
 (b3) extracting old column values and new column values of the labeled change row from the entry in the database recovery log entry; and
 (b4) extracting changed key column values and unchanged key column values associated with the row from the entry in the database recovery log entry.

10. (Currently Amended) The method of claim 9, wherein the type of the labeled change to the row comprises a row insert, a row delete, a non-key update, or a key update.

11. (Currently Amended) The method of claim 4 10, wherein the determining (e) that the captured change to the row of the given table copy is to be communicated to other table copies in the database system comprises:

(e1) examining a labeled the type of change type to the row of the given table copy, the copy identification associated with the row of the given table copy, and the propagation control values for the captured change controls associated with the row of the given table copy, wherein the propagation control values comprises a delete label and a conflict label.

12. (Currently Amended) The method of claim 11, wherein the determining (e) that the captured change to the row of the given table copy is to be communicated to other table copies in the database system further comprises:

(e2) determining that the captured change to the row of the given table copy is to be communicated to the others of the plurality of other table copies in the database system if responsive to,

the labeled change type of change to the row being is a row insert; and
if a the copy identification for the captured change associated with the row is a
being the same as a copy identification assigned to a current the given table copy.

13. (Currently Amended) The method of claim 11, wherein the determining (e) that the captured change to the row of the given table copy is to be communicated to other table copies in the database system further comprises:

(e2) determining that the captured change to the row of the given table copy is to be communicated to the others of the plurality of other table copies in the database system if responsive to,

the labeled change type of change to the row being is a row delete; and
if the delete label of the captured change associated with the row indicating indicates that the captured change is to be communicated to the other table copies in the database system.

14. (Currently Amended) The method of claim 11, wherein the determining (e) that the captured change to the row of the given table copy is to be communicated to other table copies in the database system further comprises:

(e2) determining that the captured change to the row of the given table copy is to be communicated to the others of the plurality of other table copies if responsive to,

the labeled change type of change to the row being is a non-key update or a key update; and

if neither the delete label nor the conflict label of the captured change associated with the row indicates that the captured change is not to be communicated to other table copies in the database system; and

if a new copy identification of the captured change associated with the row being is the same as the copy identification assigned to a current the given table copy.

15. (Currently Amended) The method of claim 1, wherein the communicating (d) the captured change to the other table copies in the database system comprises:

(d1) sending information for associated with the captured change to the others of the plurality of other table copies in the database system,
wherein if responsive to the captured type of change to the row being is a row insert, the information associated with the captured change comprises key column values, non-key column values, a monotonic number timestamp, and a copy identification of the captured change associated with the row of the given table copy.

16. (Currently Amended) The method of claim 1, wherein the communicating (d) the captured change to the other table copies in the database system comprises:

(d1) sending information for associated with the captured change to the others of the plurality of other table copies in the database system,
wherein if responsive to the captured type of change to the row being is a row delete, the information associated with the captured change comprises key column values, a monotonic number timestamp, and a copy identification of the captured change associated with the row of the given table copy.

17. (Currently Amended) The method of claim 1, wherein the communicating (d) the captured change to the other table copies in the database system comprises:

(d1) sending information for associated with the captured change to the others of the plurality of other table copies in the database system,
wherein if responsive to the captured type of change being is a non-key update, the information associated with the captured change comprises key column values, new non-key column values, an old monotonic number timestamp, a new monotonic number timestamp, an

old copy identification, and a new copy identification of the captured change associated with the row of the given table copy.

18. (Currently Amended) The method of claim 1, wherein the communicating (d) the captured change to the other table copies in the database system comprises:

(d1) sending information for associated with the captured change to the others of the plurality of other table copies in the database system,

wherein if responsive to the captured type of change being is a key update, the information associated with the captured change comprises old key column values, new key column values, new non-key column values, an old monotonic number timestamp, a new monotonic number timestamp, an old copy identification, and a new copy identification of the captured change associated with the row of the given table copy.

19. (Currently Amended) The method of claim 1, wherein the applying (e) the communicated change to the other table copies in the database system comprises:

(e1) detecting a conflict for the communicated change with at least one a row of a target table copy, the target table copy being a table copy among the other table copy in the database system at which changes are to be replicated;

(e2) determining a priority for the communicated change if responsive to the conflict being is detected; and

(e3) changing the row of the target table copy in accordance with the detected conflict and the determined priority for the communicated change.

20. (Currently Amended) The method of claim 19, wherein ~~the detecting (e1) a conflict for the communicated change with a row of a target table copy~~ comprises:

(e1i) if responsive to the type of the communicated change is being a row delete, the conflict is detected if responsive to,

no row of the target table copy with key column values matching key column values ~~of associated with~~ the communicated change is identified; or

for a row of the target table copy with key column values matching the key column values ~~of associated with~~ the communicated change,

a ~~monotonic number of timestamp~~ associated with the row of the target table copy does not match the ~~monotonic number of timestamp~~ associated with the communicated change; or

a copy identification of the row of the target table copy does not match a copy identification ~~of associated with~~ the communicated change.

21. (Currently Amended) The method of claim 19, wherein ~~the detecting (e1) a conflict for the communicated change with a row of a target table copy~~ further comprises:

(e1i) if responsive to the type of the communicated change is being a row insert, the conflict is detected if responsive to,

a row of the target table copy with key column values matching key column values ~~of associated with~~ the communicated change is identified.

22. (Currently Amended) The method of claim 19, wherein ~~the detecting (e1) a conflict for the communicated change with a row of a target table copy~~ further comprises:

(e1i) if responsive to the type of the communicated change is being a non-key update,
the conflict is detected if responsive to,
no rows row of the target table copy with key column values matching key column values
of associated with the communicated change is identified; or
for a row of the target table copy with key column values matching the key column
values of associated with the communicated change,
a monotonic number of timestamp associated with the row of the target table copy
does not match the an old monotonic number of timestamp associated with the
communicated change; or
a copy identification of the row of the target table copy does not match an old
copy identification of associated with the communicated charge.

23. (Currently Amended) The method of claim 19, wherein the detecting (e1) a conflict for
the communicated change with a row of a target table copy further comprises:

(e1i) if responsive to the type of the communicated change is being a key update, the
conflict is detected if responsive to,
no row of the target table copy with key column values matching old key column values
of associated with the communicated change is identified; or
for a row of the target table copy with key column values matching the old key column
values of associated with the communicated change,
a monotonic number of timestamp associated with the row of the target table copy
does not match an old monotonic number of timestamp associated with the
communication change; or

a copy identification of associated with the row of the target table copy does not match an old copy identification for associated with the communicated change; or
a row of the target table copy with key column values matching new key column values of associated with the communicated change is identified.

24. (Currently Amended) The method of claim 19, wherein the determining (e2) applying the communicated change to the other table copies in the database system comprises:

(e2i) assigning priority to the communicated change if responsive to no conflict is being detected between the communicated change and the row of the target table copy.

25. (Currently Amended) The method of claim 19, wherein the determining (e2) a priority for the communicated change comprises:

(e2i) assigning priority to the communicated change if responsive to the type of the communication change is being a row insert; and

a monotonic number of timestamp associated with the communicated change is greater than a monotonic number of timestamp associated with the conflicting row in the target table copy; or

the monotonic number of timestamp associated with the communicated change is equal to the monotonic number of timestamp associated with the conflicting row, and a copy identification of associated with the communication change is greater than a copy identification of associated with the conflicting row.

26. (Currently Amended) The method of claim 19, wherein the determining (e2) a priority for the communicated change comprises:

(e2i) assigning priority to the communicated change if responsive to the type of the communicated change is being a row delete and if responsive to,

no row in the target table copy matches key column values of associated with the communicated change; or

a monotonic-number-of timestamp associated with the communicated change is greater than a monotonic number-of timestamp associated with the conflicting row in the target table copy; or

the monotonic number-of timestamp associated with the communicated change is the same as the monotonic number-of timestamp associated with the conflicting row and a copy identification of associated with the communication change is greater than a copy identification of associated with the conflicting row.

27. (Currently Amended) The method of claim 19, wherein the determining (e2) a priority for the communicated change comprises:

(e2i) assigning priority to the communicated change if responsive to the type of the communicated change is being a non-key update and if responsive to,

no row in the target table copy matches key column values of associated with the communicated change; or

a monotonic-number-of timestamp associated with the communicated change is greater than a monotonic number-of timestamp associated with the conflicting row in the target table copy; or

the monotonic number-of timestamp associated with the communicated change is the same as the monotonic number-of timestamp associated with the conflicting row and a copy

identification of associated with the communicated change is greater than a copy identification of associated with the conflicting row.

28. (Currently Amended) The method of claim 19, wherein the determining (e2) a priority for the communicated change if the conflict is detected comprises:

(e2i) assigning priority to the communicated change if responsive to the type of the communicated change is being a key update and if responsive to,

(e2iA) no row in the target table copy matching old key column values of associated with the communicated change is identified; and

(e2iA(I)) no row in the target table copy matching new key column values of associated with the communicated change is identified; or

(e2iA(II)) a new monotonic number of timestamp associated with the communicated change is greater than a monotonic number for timestamp associated with the conflicting row in the target table copy with key column values matching new key column values of associated with the communicated change; or

(e2iA(III)) the new monotonic number of timestamp and copy identification associated with the communicated change matches the monotonic number timestamp and a copy identification of associated with the conflicting row in the target table copy with key column values matching new key column values of associated with the communicated change, respectively; or

(e2iB) an old monotonic number of timestamp associated with the communicated change is greater than the monotonic number of timestamp associated with the conflicting

row in the target table copy with key columns matching old key column values ~~of associated with~~ the communicated change; or

the ~~monotonic number of timestamp associated with~~ the communicated change matches the ~~monotonic number of timestamp associated with~~ the conflicting row and an old copy identification ~~of associated with~~ the communicated change is greater than the copy identification ~~of associated with~~ the conflicting row with key column values matching old key column values ~~of associated with~~ the communicated change; and

(e2iB(D)) no row in the target table copy matching new key column values ~~in associated with~~ the communicated change is identified; or

(e2iB(H)) the new ~~monotonic number of timestamp associated with~~ the communicated change is greater than the ~~monotonic number of timestamp associated with~~ the conflicting row with key column values matching the new key column values ~~of associated with~~ the communicated change; or

(e2iB(III)) the ~~monotonic number of timestamp associated with~~ the communicated change matches the ~~monotonic number of timestamp associated with~~ the conflicting row and the new copy identification ~~of associated with~~ the communicated change is greater than the copy identification ~~of associated with~~ the conflicting row with key column values matching the new key column values ~~of associated with~~ the communicated change.

29. (Currently Amended) The method of claim 19, wherein ~~the changing (e3) the row of the target table copy comprises:~~

(e3i) controlling propagation of the change applied to the target table copy;

(e3ii) insuring convergence of the plurality of each table copies copy in the database system to the same state; and

(e3iii) installing the communicated changes change into the target table copy.

30. (Currently Amended) The method of claim 29, wherein the controlling (e3i) propagation of the change applied to the target table copy comprises:

(e3iA) if responsive to the type of the communicated change is being a row insert, setting a copy identification of associated with the applied change to the target table copy to a copy identification received associated with the communicated change.

31. (Currently Amended) The method of claim 29, wherein the controlling (e3i) propagation of the change applied to the target table copy comprises:

(e3iA) if responsive to the type of the communicated change is being a row delete, updating a row of the target table copy with key column values matching key column values of associated with the communicated change by setting the delete label to indicate not to propagate the applied change.

32. (Currently Amended) The method of claim 29, wherein the controlling (e3i) propagation of the change applied to the target table copy comprises:

(e3iA) if responsive to the communicated change is being a non-key or key update, setting a copy identification of associated with the applied change to the target table copy to the copy identification received associated with the communicated change.

33. (Currently Amended) The method of claim 29, wherein the insuring (e3ii) convergence of each table copy in the database system to the same state comprises:

(e3iiA) insuring propagation of an implicit delete change in the target table copy by setting a conflict label of the propagation controls of associated with the conflicting row when the type of the communicated change is a row insert, row delete, or non-key update assigned priority, and a copy identification of associated with the conflicting row is a copy identification assigned to the target table copy.

34. (Currently Amended) The method of claim 29, wherein the insuring (e3ii) convergence of each table copy in the database system to the same state comprises:

(e3iiA) insuring propagation of a delete change in the target table by setting a conflict label of the propagation controls of associated with the conflicting row with key column values matching old key column values of associated with the communicated change, when the type of the communicated change is a key update assigned priority, and a copy identification of associated with the conflicting row matches a copy identification assigned to the target table copy; and

(e3iiB) insuring propagation of a delete change in the target table copy by setting a conflict label of the propagation controls of associated with the conflicting row with key column values matching new key column values of associated with the communicated change, when the type of the communicated change is a key update assigned priority, and a copy identification of associated with the conflicting row is a copy identification assigned to the target table copy.

35. (Currently Amended) The method of claim 29, wherein the insuring (e3ii) convergence of each table copy in the database system to the same state comprises:

(e3iiA) recording communicated old key column values, an old ~~monotonic number timestamp~~, and an old copy identification ~~of associated with~~ a conflicting change in the target table copy in a delete tombstone, when the type of the communicated change is a conflicting delete or a conflicting update with conflicting communicated old ~~monotonic number timestamp~~ or copy identification.

36. (Currently Amended) The method of claim 29, wherein ~~the insuring (e3ii) convergence of each table copy in the database system to the same state~~ comprises:

(e3iiA) checking for matching delete and suppressing application of the communication change ~~if responsive to~~ a delete tombstone matching the new key columns, new ~~monotonic number timestamp~~, and new copy identification ~~of associated with~~ the communicated change ~~is being~~ found, when the type of the communicated change is an insert change or an update change with a conflicting insert assigned priority.

37. (Currently Amended) The method of claim 1, further comprising:

(f) reporting each conflicting change.

38. (Currently Amended) The method of claim 37, wherein ~~the reporting (f) each conflicting change~~ comprises:

(f1) reporting conflicting changes of a row delete, a row insert, or a non-key update change only when priority is not assigned to the communicated change and a copy identification ~~for associated with~~ a conflicting row in a target table copy is the copy identification assigned to the target table copy.

39. (Currently Amended) The method of claim 37, wherein ~~the reporting (f) each conflicting change comprises:~~

(f1) reporting conflicting changes of a key update change only when priority is not assigned to the communicated change; and

a copy identification for ~~associated with~~ a conflicting row in a target table copy with key column values matching old key column values for ~~associated with~~ the communicated change is the copy identification assigned to the target table copy; or

a copy identification for ~~associated with~~ a conflicting row with key column values matching new key column values for ~~associated with~~ the communicated change is the copy identification assigned to the target table copy.

40. (Currently Amended) A database system, comprising:

~~a plurality of nodes, a plurality of table copies each node having a corresponding copy of a table, wherein each row of the plurality of each table copies are labeled with a monotonic number, a copy identification, and propagation controls copy includes,~~

~~a timestamp with the row indicating a time when a change to the row has occurred;~~

~~a copy identification, the copy identification being an identifier that uniquely identifies the table copy to which the row belongs; and~~

~~propagation controls indicating whether a change to the row should be communicated to other table copies based at least in part on the timestamp of the change or the copy identification associated with the row;~~

~~a mechanism for to asynchronously capturing capture at least one labeled a change to any a row of any of the plurality of table copies a given table copy in the database system from a~~

database recovery log, the database recovery log containing an entry that describes the change to the row of the given table copy;

a plurality of message queue queues for communicating the captured changes change to others of the plurality of other table copies in the database system; and

a mechanism for applying to apply the communicated change changes to the others of the plurality of other table copies in the database system, wherein the plurality of table copies converge each table copy in the database system converges to a same state.

41. (Currently Amended) The database system of claim 40, wherein the timestamp comprises a monotonic number comprises having a non-decreasing time value, wherein the time values for each of the plurality of table copies are table copy is in a common time base.

42. (Currently Amended) The database system of claim 41, wherein the monotonic number is automatically applied to a changed table copy timestamp is associated with the row in response to a user induced change of the row.

43. (Currently Amended) The database system of claim 40, wherein the copy identification is assigned to each of the plurality of table copy copies, wherein the copy identification uniquely identified each of the plurality of table copies, wherein the copy identifications for each of the plurality of table copies have has an ordering property.

44. (Currently Amended) The database system of claim 40, wherein the copy identification is automatically applied to a changed table copy of a given row is associated with the row in response to a user induced change of the row.

45. (Currently Amended) The database system of claim 40, wherein the propagation controls comprise a delete label and a conflict label.

46. (Currently Amended) The database system of claim 45, wherein the delete label indicates that a row delete in any of the plurality of table copies is not to be communicated to the others of the plurality of other table copies in the database system.

47. (Currently Amended) The database system of claim 45, wherein the conflict label indicates that an implicit row delete any of the plurality of table copies in a given table copy is to be communicated to the others of the plurality of other table copies in the database system, an implicit row delete being a deletion of a row due to a conflict.

48-49. (Cancelled)

50. (Currently Amended) A computer readable medium with program instructions tangibly stored thereon for providing convergence of data multiple copies of a table to a same state in asynchronous data replication in a database system, the database system including a plurality of nodes with a plurality of table copies each having a corresponding copy of the table, the computer readable medium comprising the instructions for:

(a) labeling rows of the plurality of table copies with a monotonic number, a copy identification, and propagation controls; for each row of each table copy, associating a timestamp with the row, the timestamp indicating a time when a change to the row has occurred;

associating a copy identification to the row, the copy identification being an identifier that uniquely identifies the table copy to which the row belongs; and associating propagation controls with the row, the propagation controls indicating whether a change to the row should be communicated to other table copies based at least in part on the timestamp of the change or the copy identification associated with the row;

- (b) asynchronously capturing at least one labeled a change to any a row of a given table copy any of the plurality of table copies from a database recovery log, the database recovery log containing an entry that describes the change to the row of the given table copy;
- (c) determining that the captured change to the row of the given table copy is to be communicated to others of the plurality of other table copies in the database system, the determination being made in accordance with the indication of the propagation controls associated with the changed row of the given table copy;
- (d) communicating the captured change to the others of the plurality of other table copies in the database system; and
- (e) applying the communicated change to the others of the plurality of other table copies in the database system, wherein the plurality of table copies converge each table copy in the database system converges to a same state.

51. (Currently Amended) The computer readable medium of claim 50, wherein timestamp comprises a monotonic number comprises having a non-decreasing time value, wherein the time values for each of the plurality of table copies are table copy is in a common time base.

52. (Currently Amended) The computer readable medium of claim 51, wherein the monotonic number is automatically applied to a changed table copy instructions for associating a

timestamp with the row include instructions for associating the timestamp with the row in response to a user induced change of the row.

53. (Currently Amended) The computer readable medium of claim 50, ~~wherein the copy identification is assigned to each of the plurality of table copies, wherein the copy identification uniquely identifies each of the plurality of table copies, wherein the copy identifications for identification uniquely identifying each of the plurality of table copies have table copy has~~ an ordering property.

54. (Currently Amended) The computer readable medium of claim 53, ~~wherein the eopy identification is automatically applied to a changed table copy instructions for associating a copy identification to the row include instructions for associating the copy identification to the row in response to a user induced change of the row.~~

55. (Currently Amended) The computer readable medium of claim 50, wherein the propagation controls comprise a delete label and a conflict label.

56. (Currently Amended) The computer readable medium of claim 55, wherein the delete label indicates that a row delete in ~~any of the plurality of table copies a given table copy~~ is not to be communicated to ~~the others of the plurality of other table copies in the database system~~.

57. (Currently Amended) The computer readable medium of claim 55, wherein the conflict label indicates that an implicit row delete in ~~any of the plurality of table copies a given table~~

copy is to be communicated to the others of the plurality of other table copies in the database system, an implicit row delete being a deletion of a row due to a conflict.

58. (Currently Amended) The computer readable medium of claim 50, wherein the instructions for asynchronously capturing instruction (b) comprises a change to a row of a given table copy include instructions for:

- (b1) accessing at least one the entry of the database recovery log pertaining to the labeled change of the row;
- (b2) determining a type of the labeled change to the row;
- (b3) extracting old column values and new column values of the labeled change row from the entry in the database recovery log entry; and
- (b4) extracting changed key column values and unchanged key column values associated with the row from the entry in the database recovery log entry.

59. (Currently Amended) The computer readable medium of claim 58, wherein the type of the labeled change to the row comprises a row insert, a row delete, a non-key update, or a key update.

60. (Currently Amended) The computer readable medium of claim 50 59, wherein the instructions for determining instruction (c) comprises that the captured change to the row of the given table copy is to be communicated to other table copies in the database system include instructions for:

- (c1) examining a labeled the type of change type to the row of the given table copy, the copy identification associated with the row of the given table copy, and the propagation control

~~values for the captured change controls associated with the row of the given table copy., wherein the propagation control values comprises a delete label and a conflict label.~~

61. (Currently Amended) The computer readable medium of claim 60, wherein the instructions for determining instruction (e) that the captured change to the row of the given table copy is to be communicated to other table copies in the database system further comprises include instructions for:

(e2) determining that the captured change to the row of the given table copy is to be communicated to the others of the plurality of other table copies in the database system responsive to,

if the labeled change type of change to the row being is a row insert; and
if a the copy identification for the captured change associated with the row being
is a the same as a copy identification assigned to a current the given table copy.

62. (Currently Amended) The computer readable medium of claim 60, wherein the instructions for determining instruction (e) that the captured change to the row of the given table copy is to be communicated to other table copies in the database system further comprises include instructions for:

(e2) determining that the captured change to the row of the given table copy is to be communicated to the others of the plurality of other table copies in the database system if responsive to,

the labeled change type of change to the row being is a row delete; and

~~if the delete label of the captured change associated with the row indicating indicates that the captured change is to be communicated to the other table copies in the database system.~~

63. (Currently Amended) The computer readable medium of claim 60, wherein the instructions for determining instruction (e) that the captured change to the row of the given table copy is to be communicated to other table copies in the database system further comprises include instructions for:

(e2) determining that the captured change to the row of the given table copy is to be communicated to the others of the plurality of other table copies in the database system if responsive to,

the labeled change type of change to the row being is a non-key update or a key update; and

if neither the delete label nor the conflict label of the captured change associated with the row indicates that the captured change is not to be communicated to other table copies in the database system; and

if a new copy identification of the captured change associated with the row is a the same as the copy identification assigned to a current the given table copy.

64. (Currently Amended) The computer readable medium of claim 50, wherein the instructions for communicating instruction (d) comprises the captured change to the other table copies in the database system include instructions for:

(d1) sending information for the captured change to the others of the plurality of table copies,

wherein if responsive to the captured change is being a row insert, the information comprises key column values, non-key column values, a monotonic number, and a copy identification of the captured change.

65. (Currently Amended) The computer readable medium of claim 50, wherein the instructions for communicating instruction (d) comprises the captured change to the other table copies in the database system include instructions for:

(d1) sending information for the captured change to the others of the plurality of table copies,

wherein if responsive to the captured change is being a row delete, the information comprises key column values, a monotonic number, and a copy identification of the captured change.

66. (Currently Amended) The computer readable medium of claim 50, wherein the instructions for communicating instruction (d) comprises the captured change to the other table copies in the database system include instructions for:

(d1) sending information for the captured change to the others of the plurality of table copies,

wherein if responsive to the captured change is being a non-key update, the information comprises key column values, new non-key column values, an old monotonic number, a new monotonic number, an old copy identification, and a new copy identification of the captured change.

67. (Currently Amended) The computer readable medium of claim 50, wherein the instructions for communicating instruction (d) comprises the captured change to the other table copies in the database system include instructions for:

(d1) sending information ~~for associated with~~ the captured change to ~~others of the plurality of other~~ table copies in the database system,
wherein ~~if responsive to the captured type of change to the row being~~ is a key update, the information associated with the captured change comprises old key column values, new key column values, new non-key column values, an old ~~monotonic number~~ timestamp, a new ~~monotonic number~~ timestamp, an old copy identification, and a new copy identification ~~of the captured change associated with the row of the given table copy~~.

68. (Currently Amended) The computer readable medium of claim 50, wherein the instructions for applying instruction (e) comprises the communicated change to the other table copies in the database system include instructions for:

(e1) detecting a conflict for the communicated change with ~~at least one~~ a row of a target table copy, the target table copy being a table copy among the other table copy in the database system at which changes are to be replicated;
(e2) determining a priority for the communicated change ~~if responsive to the conflict is being detected; and~~
(e3) changing the row of the target table copy in accordance with the detected conflict and the determined priority for the communicated change.

69. (Currently Amended) The computer readable medium of claim 68, wherein the instructions for detecting instruction (e1) comprises a conflict for the communicated change with a row of a target table copy include instructions for:

(e1i) if responsive to the type of the communicated change is being a row delete, the conflict is detected if responsive to,

no row of the target table copy with key column values matching key column values of associated with the communicated change is identified; or

for a row of the target table copy with key column values matching the key column values of associated with the communicated change,

a monotonic number of timestamp associated with the row of the target table copy does not match the monotonic number of timestamp associated with the communicated change; or

a copy identification of the row of the target table copy does not match a copy identification of associated with the communicated change.

70. (Currently Amended) The computer readable medium of claim 68, wherein the instructions for detecting instruction (e1) further comprises a conflict for the communicated change with a row of a target table copy further include instructions for:

(e1i) if responsive to the type of the communicated change is being a row insert, the conflict is detected if responsive to a row of the target table copy with key column values matching key column values of associated with the communicated change is being identified.

71. (Currently Amended) The computer readable medium of claim 68, wherein the instructions for detecting instruction (e1) further comprises a conflict for the communicated change with a row of a target table copy further include instructions for:

(e1i) if responsive to the type of the communicated change is being a non-key update, the conflict is detected if responsive to,

no rows of the target table copy with key column values matching key column values of associated with the communicated change is identified; or

for a row of the target table copy with key column values matching the key column values of associated with the communicated change,

a monotonic number of timestamp associated with the row of the target table copy does not match the an old monotonic number of timestamp associated with the communicated change; or

a copy identification of the row of the target table copy does not match an old copy identification of associated with the communicated charge.

72. (Currently Amended) The computer readable medium of claim 68, wherein the instructions for detecting instruction (e1) further comprises a conflict for the communicated change with a row of a target table copy further include instructions for:

(e1i) if responsive to the type of the communicated change is being a key update, the conflict is detected if responsive to,

no row of the target table copy with key column values matching old key column values of associated with the communicated change is identified; or

for a row of the target table copy with key column values matching the old key column values of associated with the communicated change,

a ~~monotonic number of timestamp~~ associated with the row of the target table copy does not match an old ~~monotonic number of timestamp~~ associated with the communication change; or

a copy identification of ~~associated with~~ the row of the target table copy does not match an old copy identification for ~~associated with~~ the communicated change; or

a row of the target table copy with key column values matching new key column values of ~~associated with~~ the communicated change is identified.

73. (Currently Amended) The computer readable medium of claim 68, wherein the ~~determining instruction (e2) comprises instructions for applying the communicated change to the other table copies in the database system include~~ instructions for:

(e2i) assigning priority to the communicated change if responsive to no conflict is being detected between the communicated change and the row of the target table copy.

74. (Currently Amended) The computer readable medium of claim 68, wherein the ~~instructions for determining instruction (e2) comprises a priority for the communicated change include~~ instructions for:

(e2i) assigning priority to the communicated change if responsive to the type of the communication change is being a row insert; and

a ~~monotonic number of timestamp~~ associated with the communicated change is greater than a ~~monotonic number of timestamp~~ associated with the conflicting row in the target table copy; or

the ~~menetonic number of timestamp~~ associated with the communicated change is equal to the ~~monotonic number of timestamp~~ associated with the conflicting row; and

a copy identification of associated with the communication change is greater than a copy identification of associated with the conflicting row.

75. (Currently Amended) The computer readable medium of claim 68, wherein the instructions for determining instruction-(e2)-comprises a priority for the communicated change include instructions for:

(e2i) assigning priority to the communicated change if responsive to the type of the communicated change is being a row delete and if responsive to,

no row in the target table copy matches key column values of associated with the communicated change; or

a monotonic-number-of timestamp associated with the communicated change is greater than a monotonic-number-of timestamp associated with the conflicting row in the target table copy; or

the monotonic-number-for timestamp associated with the communicated change is the same as the monotonic-number-for timestamp associated with the conflicting row and a copy identification of associated with the communication change is greater than a copy identification of associated with the conflicting row.

76. (Currently Amended) The computer readable medium of claim 68, wherein the instructions for determining instruction-(e2)-comprises a priority for the communicated change include instructions for:

(e2i) assigning priority to the communicated change if responsive to the type of the communicated change is being a non-key update and if responsive to,

no row in the target table copy matches key column values ~~of associated with~~ the communicated change; or

a ~~monotonic number of timestamp associated with~~ the communicated change is greater than a ~~monotonic number of timestamp associated with~~ the conflicting row in the target table copy; or

the monotonic ~~number of timestamp associated with~~ the communicated change is the same as the ~~monotonic number of timestamp associated with~~ the conflicting row and a copy identification ~~of associated with~~ the communicated change is greater than a copy identification ~~of associated with~~ the conflicting row.

77. (Currently Amended) The computer readable medium of claim 68, wherein the instructions for determining instruction (e2) comprises a priority for the communicated change include instructions for:

(e2i) assigning priority to the communicated change if responsive to the type of the communicated change is being a key update and if responsive to,

(e2iA) no row in the target table copy matching old key column values ~~of~~ associated with the communicated change is identified; and

(e2iA(I)) no row in the target table copy matching new key column values ~~of~~ associated with the communicated change is identified; or

(e2iA(II)) a new ~~monotonic number of timestamp associated with~~ the communicated change is greater than a ~~monotonic number for timestamp~~ associated with the conflicting row in the target table copy with key column values matching new key column values ~~of~~ associated with the communicated change; or

(e2iA(III)) the new ~~monotonic number~~ timestamp and a copy identification of associated with the communicated change matches the ~~monotonic number~~ timestamp and a copy identification of associated with the conflicting row in the target table copy with key column values matching new key column values of associated with the communicated change, respectively; or

(e2iB) an old ~~monotonic number~~ of timestamp associated with the communicated change is greater than the ~~monotonic number~~ of timestamp associated with the conflicting row in the target table copy with key columns matching old key column values of associated with the communicated change; or

the ~~monotonic number~~ of timestamp associated with the communicated change matches the ~~monotonic number~~ of timestamp associated with the conflicting row and an old copy identification of associated with the communicated change is greater than the copy identification of associated with the conflicting row with key column values matching old key column values of associated with the communicated change; and

(e2iB(I)) no row in the target table copy matching new key column values in associated with the communicated change is identified; or

(e2iB(II)) the new ~~monotonic number~~ of timestamp associated with the communicated change is greater than the ~~monotonic number~~ of timestamp associated with the conflicting row with key column values matching the new key column values of associated with the communicated change; or

(e2iB(III)) the ~~monotonic number~~ of timestamp associated with the communicated change matches the ~~monotonic number~~ of timestamp associated with the conflicting row and the new copy identification of associated with the communicated change is greater than the copy identification of associated with

the conflicting row with key column values matching the new key column values
of associated with the communicated change.

78. (Currently Amended) The computer readable medium of claim 68, wherein the
instructions for changing instruction (e3) comprises the row of the target table copy include
instructions for:

- (e3i) controlling propagation of the change applied to the target table copy;
- (e3ii) insuring convergence of the plurality of each table copies copy in the database
system to the same state; and
- (e3iii) installing the communicated changes change into the target table copy.

79. (Currently Amended) The computer readable medium of claim 78, wherein the
instructions for controlling instruction (e3i) comprises propagation of the change applied to the
target table copy include instructions for:

- (e3iA) if responsive to the type of the communicated change is being a row insert,
setting a copy identification of associated with the applied change to the target table copy to a
copy identification received associated with the communicated change.

80. (Currently Amended) The computer readable medium of claim 78, wherein the
instructions for controlling instruction (e3i) comprises propagation of the change applied to the
target table copy include instructions for:

- (e3iA) if responsive to the type of the communicated change is being a row delete,
updating a row of the target table copy with key column values matching key column values of

associated with the communicated change by setting the delete label to indicate not to propagate the applied change.

81. (Currently Amended) The computer readable medium of claim 78, wherein the controlling instruction (e3i) comprises instructions for:

(e3iA) if responsive to the type of the communicated change is being a non-key or key update, setting a copy identification of the applied change to the target table copy to the copy identification received with the communicated change.

82. (Currently Amended) The computer readable medium of claim 78, wherein the instructions for insuring instruction-(e3ii) comprises convergence of each table copy in the database system to the same state include instructions for:

(e3iiA) insuring propagation of an implicit delete change in the target table copy by setting a conflict label of the propagation controls of associated with the conflicting row when the type of the communicated change is a row insert, a row delete, or a non-key update assigned priority and a copy identification of associated with the conflicting row is a copy identification assigned to the target table copy.

83. (Currently Amended) The computer readable medium of claim 78, wherein the instructions for insuring instruction (e3ii) comprises convergence of each table copy in the database system to the same state include instructions for:

(e3iiA) insuring propagation of a delete change in the target table by setting a conflict label of the propagation controls of associated with the conflicting row with key column values matching old key column values of associated with the communicated change, when the type of

the communicated change is a key update assigned priority and a copy identification of associated with the conflicting row matches a copy identification assigned to the target table copy.

84. (Currently Amended) The computer readable medium of claim 78, wherein the instructions for insuring instruction (e3ii) comprises convergence of each table copy in the database system to the same state include instructions for:

(e3iiA) recording communicated old key column values, an old monotonic number timestamp, and an old copy identification of associated with a conflicting change in the target table copy in a delete tombstone, when the type of the communicated change is a conflicting delete or a conflicting update with conflicting communicated old monotonic number timestamp or copy identification.

85. (Currently Amended) The computer readable medium of claim 78, wherein the instructions for insuring instruction (e3ii) comprises convergence of each table copy in the database system to the same state include instructions for:

(e3iiA) checking for matching delete and suppressing application of the communication change if responsive to a delete tombstone matching new key column values, new monotonic number timestamp, and new copy identification of associated with the communicated change is found, when the type of the communicated change is an insert change or an update change with a conflicting insert assigned priority.

86. (Currently Amended) The computer readable medium of claim 50, further comprising instructions for:

(f) reporting each conflicting change.

87. (Currently Amended) The computer readable medium of claim 86, wherein the instructions for reporting instruction (f) comprises each conflicting change include instructions for:

(f1) reporting conflicting changes of a row delete, a row insert, or a non-key update change only when priority is not assigned to the communicated change and a copy identification for associated with a conflicting row in a target table copy is the copy identification assigned to the target table copy.

88. (Currently Amended) The computer readable medium of claim 86, wherein the instructions for reporting instruction (f) comprises each conflicting change include instructions for:

(f1) reporting conflicting changes of a key update change only when priority is not assigned to the communicated change; and

a copy identification for associated with a conflicting row in a target table copy with key column values matching old key column values for associated with the communicated change is the copy identification assigned to the target table copy; or

a copy identification for associated with a conflicting row with key column values matching new key column values of associated with the communicated change is the copy identification assigned to the target table copy.

89-90. (Cancelled)